SEQUENCE LISTING

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Ling, Kai-Shu

<120> GRAPEVINE LEAFROLL VIRUS PROTEINS AND THEIR USES

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<151> 1998-04-29

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<210> 3

<211> 6714
<212> DNA
<213> grapevine leafroll-associated virus 3

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<211> 360
<212> DNA
<213> grapevine leafroll-associated virus 3

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<210> 5
<211> 120
<212> PRT
<213> grapevine leafroll-associated virus 3

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Asp Val Val Phe Glu Ala Val Ser Asn Ala Leu Leu Val Val His Tyr

35 40 45

His Arg Val Val Pro Tyr Ala Pro Val Lys Arg Glu Gln Pro Lys Pro
50 55 60

Ala Val Lys Gln Asp Glu Gln Lys Pro Lys Arg Gln Ala Ser His Trp
65 70 75 80

Ala Val Lys Pro Thr Ala Val Gly Val His Val Pro Leu Pro Lys Lys
85 90 95

Gln Glu Ala Leu Glu Pro Ala Gln Ser Val Pro Gln Gln Ser Leu Glu
100 105 110

Glu Lys Ala Ala Leu Thr Phe Gly
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<211> 816
<212> DNA
<213> grapevine leafroll-associated virus 3

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<210> 7
<211> 272
<212> PRT
<213> grapevine leafroll-associated virus 3

<400> 7
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```
Ser Ile Gln Phe Ser Asp Ser Val Arg Ser Ser His Pro Phe Ala Asn
            20                  25                  30

Ala Met Arg Ser Cys Phe Asn Gly Ile Phe Ser Arg Arg Cys Gly Asn
        35                  40                  45

Val Cys Phe Phe Asp Ile Gly Gly Ser Phe Thr Tyr His Val Lys Ala
    50                  55                  60

Gly His Val Asn Cys His Val Cys Asn Pro Val Leu Asp Val Lys Asp
65                  70                  75                  80

Val Lys Arg Arg Ile Asn Glu Ile Leu Phe Leu Ser Thr Ala Gly Gly
                85                  90                  95

Asp Ser Tyr Val Ser Ser Asp Leu Leu Thr Glu Ala Ala Ser Lys Ser
            100                 105                 110

Val Ser Tyr Cys Ser Arg Glu Ser Gln Asn Cys Asp Ser Arg Ala Asp
        115                 120                 125

Ala Gly Phe Met Val Asp Val Tyr Asp Ile Ser Pro Gln Gln Val Ala
    130                 135                 140

Glu Ala Met Asp Lys Lys Gly Ala Leu Val Phe Asp Ile Ala Leu Met
145                 150                 155                 160

Phe Pro Val Glu Leu Leu Tyr Gly Asn Gly Glu Val Tyr Leu Glu Glu
                165                 170                 175

Leu Asp Thr Leu Val Lys Arg Glu Gly Asp Tyr Leu Ala Tyr Asn Val
            180                 185                 190

Gly Gln Cys Gly Glu Met Tyr Glu His Ser Phe Ser Asn Val Ser Gly
        195                 200                 205

Phe Phe Thr Phe Ser Tyr Val Arg Thr Ser Ser Gly Asn Val Phe Lys
    210                 215                 220

Leu Glu Tyr Glu Gly Tyr Arg Cys Gly Tyr His His Leu Thr Met Cys
225                 230                 235                 240

Arg Ala Gln Lys Ser Pro Gly Thr Glu Val Thr Tyr Arg Ser Leu Val
                245                 250                 255

Pro Ser Phe Val Gly Lys Ser Leu Val Phe Ile Pro Val Val Ala Gly
            260                 265                 270
```

<210> 8
<211> 873
<212> DNA
<213> grapevine leafroll-associated virus 3

<400> 8
```
gtgggcgaat cgtttaagtc cttcgaatat aagtgctata atgctccccc aggtggcggt 60
aagacgacga cgttagtgga cgaattcgtt aagtcaccca atagcacagc caccattacg 120
gctaatgtgg gaagttctga ggacataaat atggcggtga agaagagaga tccgaatttg 180
gaaggtctca acagtgctac cacagttaac tccagggtgg taaactttat cgtcagggga 240
atgtataaaa gggttttggt ggatgaggtg cacatgatgc atcaaggctt actacaacta 300
ggcgtcttcg caaccggcgc gtcggaaggc ctcttttttg gagacataaa tcagatacca 360
ttcataaaca gggagaaggt gtttaggatg gattgtgctg tttttgttcc aaagaaggaa 420
agcgttgtat acacttctaa atcgtacagg tgtccgttag atgtttgcta cttgttgtcc 480
tcaatgaccg taaggggaac ggaaaagtgt taccctgaaa aggtcgttag cggtaaggac 540
aaaccagtag taagatcgct gtccaaaagg ccaattggaa ccactgatga cgtagctgaa 600
ataaacgctg acgtgtactt gtgcatgacc cagttggaga agtcggatat gaagaggtcg 660
ttgaagggaa aaggaaaaga aacaccagtg atgacagtgc atgaagcaca gggaaaaaca 720
ttcagtgatg tggtattgtt taggacgaag aaagccgatg actccctatt cactaaacaa 780
ccgcatatac ttgttggttt gtcgagacac acacgctcac tggtttatgc cgctctgagc 840
tcaaagttgg acgataaggt cggcacatat att                              873
```

<210> 9
<211> 291
<212> PRT
<213> grapevine leafroll-associated virus 3

<400> 9
```
Val Gly Glu Ser Phe Lys Ser Phe Glu Tyr Lys Cys Tyr Asn Ala Pro
1               5                   10                  15

Pro Gly Gly Gly Lys Thr Thr Thr Leu Val Asp Glu Phe Val Lys Ser
            20                  25                  30

Pro Asn Ser Thr Ala Thr Ile Thr Ala Asn Val Gly Ser Ser Glu Asp
        35                  40                  45

Ile Asn Met Ala Val Lys Lys Arg Asp Pro Asn Leu Glu Gly Leu Asn
    50                  55                  60

Ser Ala Thr Thr Val Asn Ser Arg Val Val Asn Phe Ile Val Arg Gly
65                  70                  75                  80

Met Tyr Lys Arg Val Leu Val Asp Glu Val His Met Met His Gln Gly
```

```
                85                  90                  95

Leu Leu Gln Leu Gly Val Phe Ala Thr Gly Ala Ser Glu Gly Leu Phe
            100                 105                 110

Phe Gly Asp Ile Asn Gln Ile Pro Phe Ile Asn Arg Glu Lys Val Phe
        115                 120                 125

Arg Met Asp Cys Ala Val Phe Val Pro Lys Lys Glu Ser Val Val Tyr
    130                 135                 140

Thr Ser Lys Ser Tyr Arg Cys Pro Leu Asp Val Cys Tyr Leu Leu Ser
145                 150                 155                 160

Ser Met Thr Val Arg Gly Thr Glu Lys Cys Tyr Pro Glu Lys Val Val
                165                 170                 175

Ser Gly Lys Asp Lys Pro Val Val Arg Ser Leu Ser Lys Arg Pro Ile
            180                 185                 190

Gly Thr Thr Asp Asp Val Ala Glu Ile Asn Ala Asp Val Tyr Leu Cys
        195                 200                 205

Met Thr Gln Leu Glu Lys Ser Asp Met Lys Arg Ser Leu Lys Gly Lys
    210                 215                 220

Gly Lys Glu Thr Pro Val Met Thr Val His Glu Ala Gln Gly Lys Thr
225                 230                 235                 240

Phe Ser Asp Val Val Leu Phe Arg Thr Lys Lys Ala Asp Asp Ser Leu
                245                 250                 255

Phe Thr Lys Gln Pro His Ile Leu Val Gly Leu Ser Arg His Thr Arg
            260                 265                 270

Ser Leu Val Tyr Ala Ala Leu Ser Ser Lys Leu Asp Asp Lys Val Gly
        275                 280                 285

Thr Tyr Ile
    290
```

<210> 10
<211> 1599
<212> DNA
<213> grapevine leafroll-associated virus 3

<400> 10

atgaattttg gaccgacctt cgaaggggag ttggtacgga agataccaac aagtcatttt 60
gtagccgtga atgggtttct cgaggactta ctcgacggtt gtccggcttt cgactatgac 120
ttctttgagg atgatttcga aacttcagat cagtctttcc tcatagaaga tgtgcgcatt 180
tctgaatctt tttctcattt tacgtcgaaa atagaggata ggttttacag ttttattagg 240
tctagcgtag gtttaccaaa gcgcaacacc ttgaagtgta acctcgtcac gtttgaaaat 300
aggaatttca acgccgatcg cggttgtaac gtgggttgtg acgactctgt ggcgcatgaa 360
ctgaaggaga ttttcttcga ggaggtcgtt aacaaagctc gtttagcaga ggtgacggaa 420
agccatttgt ccagcaacac gatgttgtta tcagattggt tggacaaaag ggcacctaac 480
gcttacaagt ctctcaagcg ggctttaggt tcgtttgtct ttcatccgtc tatgttgact 540
tcttatacgc tcatggtgaa agcagacgta aaacccaagt tggacaatac gccattgtcg 600
aagtacgtaa cggggcagaa tatagtctac cacgataggt gcgtaactgc gctttttct 660
tgcattttta ctgcgtgcgt agagcgctta aaatacgtag tggacgaaag gtggctcttc 720
taccacggga tggacactgc ggagttggcg gctgcattga ggaacaattt gggggacatc 780
cggcaatact acacctatga actggatatc agtaagtacg acaaatctca gagtgctctc 840
atgaagcagg tggaggagtt gatactcttg acacttggtg ttgatagaga agttttgtct 900
actttctttt gtggtgagta tgatagcgtc gtgagaacga tgacgaagga attggtgttg 960
tctgtcggct ctcagaggcg cagtggtggt gctaacacgt ggttgggaaa tagtttagtc 1020
ttgtgcacct tgttgtccgt agtacttagg ggattagatt atagttatat tgtagttagc 1080
ggtgatgata gccttatatt tagtcggcag ccgttggata ttgatacgtc ggttctgagc 1140
gataattttg gttttgacgt aaagattttt aaccaagctg ctccatattt ttgttctaag 1200
tttttagttc aagtcgagga tagtctcttt tttgttcccg atccacttaa actcttcgtt 1260
aagtttggag cttccaaaac ttcagatatc gacctttac atgagatttt tcaatctttc 1320
gtcgatcttt cgaagggttt caatagagag gacgtcatcc aggaattagc taagctggtg 1380
acgcggaaat ataagcattc gggatggacc tactcggctt tgtgtgtctt gcacgtttta 1440
agtgcaaatt tttcgcagtt ctgtaggtta tattaccaca atagcgtgaa tctcgatgtg 1500
cgccctattc agaggaccga gtcgctttcc ttgctggcct tgaaggcaag aattttaagg 1560
tggaaagctt ctcgttttgc cttttcgata aagaggggt 1599

<210> 11
<211> 533
<212> PRT
<213> grapevine leafroll-associated virus 3

<400> 11
Met Asn Phe Gly Pro Thr Phe Glu Gly Glu Leu Val Arg Lys Ile Pro
1 5 10 15

Thr Ser His Phe Val Ala Val Asn Gly Phe Leu Glu Asp Leu Leu Asp
20 25 30

Gly Cys Pro Ala Phe Asp Tyr Asp Phe Phe Glu Asp Asp Phe Glu Thr
35 40 45

Ser Asp Gln Ser Phe Leu Ile Glu Asp Val Arg Ile Ser Glu Ser Phe
50 55 60

Ser His Phe Thr Ser Lys Ile Glu Asp Arg Phe Tyr Ser Phe Ile Arg
65 70 75 80

Ser Ser Val Gly Leu Pro Lys Arg Asn Thr Leu Lys Cys Asn Leu Val
85 90 95

Thr Phe Glu Asn Arg Asn Phe Asn Ala Asp Arg Gly Cys Asn Val Gly
100 105 110

Cys Asp Asp Ser Val Ala His Glu Leu Lys Glu Ile Phe Phe Glu Glu
115 120 125

Val Val Asn Lys Ala Arg Leu Ala Glu Val Thr Glu Ser His Leu Ser
130 135 140

Ser Asn Thr Met Leu Leu Ser Asp Trp Leu Asp Lys Arg Ala Pro Asn
145 150 155 160

Ala Tyr Lys Ser Leu Lys Arg Ala Leu Gly Ser Phe Val Phe His Pro
165 170 175

Ser Met Leu Thr Ser Tyr Thr Leu Met Val Lys Ala Asp Val Lys Pro
180 185 190

Lys Leu Asp Asn Thr Pro Leu Ser Lys Tyr Val Thr Gly Gln Asn Ile
195 200 205

Val Tyr His Asp Arg Cys Val Thr Ala Leu Phe Ser Cys Ile Phe Thr
210 215 220

Ala Cys Val Glu Arg Leu Lys Tyr Val Val Asp Glu Arg Trp Leu Phe
225 230 235 240

Tyr His Gly Met Asp Thr Ala Glu Leu Ala Ala Ala Leu Arg Asn Asn
245 250 255

Leu Gly Asp Ile Arg Gln Tyr Tyr Thr Tyr Glu Leu Asp Ile Ser Lys
260 265 270

Tyr Asp Lys Ser Gln Ser Ala Leu Met Lys Gln Val Glu Glu Leu Ile
275 280 285

Leu Leu Thr Leu Gly Val Asp Arg Glu Val Leu Ser Thr Phe Phe Cys
290 295 300

Gly Glu Tyr Asp Ser Val Val Arg Thr Met Thr Lys Glu Leu Val Leu
305 310 315 320

Ser Val Gly Ser Gln Arg Arg Ser Gly Gly Ala Asn Thr Trp Leu Gly
325 330 335

Asn Ser Leu Val Leu Cys Thr Leu Leu Ser Val Val Leu Arg Gly Leu
340 345 350

Asp Tyr Ser Tyr Ile Val Val Ser Gly Asp Asp Ser Leu Ile Phe Ser
355 360 365

Arg Gln Pro Leu Asp Ile Asp Thr Ser Val Leu Ser Asp Asn Phe Gly
370 375 380

Phe Asp Val Lys Ile Phe Asn Gln Ala Ala Pro Tyr Phe Cys Ser Lys
385 390 395 400

Phe Leu Val Gln Val Glu Asp Ser Leu Phe Phe Val Pro Asp Pro Leu
405 410 415

Lys Leu Phe Val Lys Phe Gly Ala Ser Lys Thr Ser Asp Ile Asp Leu
420 425 430

Leu His Glu Ile Phe Gln Ser Phe Val Asp Leu Ser Lys Gly Phe Asn
435 440 445

Arg Glu Asp Val Ile Gln Glu Leu Ala Lys Leu Val Thr Arg Lys Tyr
450 455 460

Lys His Ser Gly Trp Thr Tyr Ser Ala Leu Cys Val Leu His Val Leu
465 470 475 480

Ser Ala Asn Phe Ser Gln Phe Cys Arg Leu Tyr Tyr His Asn Ser Val
485 490 495

Asn Leu Asp Val Arg Pro Ile Gln Arg Thr Glu Ser Leu Ser Leu Leu
500 505 510

Ala Leu Lys Ala Arg Ile Leu Arg Trp Lys Ala Ser Arg Phe Ala Phe
515 520 525

Ser Ile Lys Arg Gly
530

<210> 12
<211> 111
<212> DNA
<213> grapevine leafroll-associated virus 3

<400> 12
atgttatgtt gttcagccag tgtcaaattt tcaaacgggt tacaattatc gctacttatt 60

tgcgcatgtt tgttagcggt gctaattgtt agcttttgta gaaggcgatg a 111

<210> 13
<211> 36
<212> PRT
<213> grapevine leafroll-associated virus 3

<400> 13
Met Leu Cys Cys Ser Ala Ser Val Lys Phe Ser Asn Gly Leu Gln Leu
1 5 10 15

Ser Leu Leu Ile Cys Ala Cys Leu Leu Ala Val Leu Ile Val Ser Phe
20 25 30

Cys Arg Arg Arg
35

<210> 14
<211> 279
<212> DNA
<213> grapevine leafroll-associated virus 3

<400> 14
aaaaatcctt caataaattt gaaataaaca aaagtaagaa aaatgaaata attaggctag 60
tctttttgtt cgtctttcgc ttttgtagaa taggttttat ttcgaggtaa gatgactaaa 120
ctttacctca cggtttaata ctctgatatt tgtaaaatta gtccgtaaag tcgatagtga 180
tattatatta gtatagtata ataaacgcca aaatccaatt aaagtttggg acctaggcgg 240
gcctcttacg aggctaactt atcgacaata agttaggtc 279

<210> 15
<211> 2237
<212> PRT
<213> grapevine leafroll-associated virus 3

<400> 15
Met Asp Tyr Ile Arg Pro Leu Arg Val Phe Ser Phe Pro His Val Asn
1 5 10 15

Asn Thr Leu Glu Tyr Val Arg Tyr Asn Lys Ala Asn Gly Asp Val Gly
20 25 30

Ala Phe Leu Thr Thr Met Lys Phe Ile Gly Asn Val Lys Leu Ser Asp
35 40 45

Phe Thr Pro Arg Cys Ala Ala Met Ile Tyr Ile Gly Lys Leu Thr Lys
50 55 60

Gly Val Lys Arg Thr Phe Val Pro Pro Pro Val Lys Gly Phe Ala Arg
65 70 75 80

Gln Tyr Ala Val Val Ser Gly Ser Val Ser Ala Leu Arg Gly Asp Gly
85 90 95

Lys Lys Val Leu Met Glu Ala Arg Thr Ser Thr Ser Ala Thr Ser Asp
100 105 110

Val Ser Asp Phe Asp Val Val Phe Glu Ala Val Ser Asn Ala Leu Leu
115 120 125

Val Val His Tyr His Arg Val Val Pro Tyr Ala Pro Val Lys Arg Glu
130 135 140

Gln Pro Lys Pro Ala Val Lys Gln Asp Glu Gln Lys Pro Lys Arg Gln
145 150 155 160

Ala Ser His Trp Ala Val Lys Pro Thr Ala Val Gly Val His Val Pro
165 170 175

Leu Pro Lys Lys Gln Glu Ala Leu Glu Pro Ala Gln Ser Val Pro Gln
180 185 190

Gln Ser Leu Glu Glu Lys Ala Ala Leu Thr Phe Gly Leu Phe Phe Ser
195 200 205

Lys Gly Gly Gly Asp Glu Ser Asp Ala Val Ile Leu Arg Lys Gly Lys
210 215 220

Leu Phe Asn Arg Ala Leu Asn Val Pro Ile Asp Val Lys Asn Thr Phe
225 230 235 240

Val Trp Ala Lys Ile Trp Asp Glu Ala Ser Arg Arg Arg Gly Tyr Phe
245 250 255

Tyr Val Lys Asp Arg Ala Val Lys Phe Phe Pro Ile Val Arg Gly Arg
260 265 270

Ala Thr Ile Glu Asp Phe Ile Val Asn Thr Ala Pro Gly Cys Asp Val
275 280 285

Ala Leu Pro Arg Ile Glu Leu Trp Ser Met Arg Glu Arg Ala Phe Val
290 295 300

Cys Thr Thr Lys Gly Trp Cys Trp Phe Asn Asn Glu Arg Leu Arg Gly
305 310 315 320

Glu Ile Tyr Arg Arg Arg Cys Phe Ser Ser Ser Phe Ser Ile Gly Phe
325 330 335

Leu Met His Leu Gly Phe Arg Ser Leu Lys Val Ile Arg Phe Ala Gly
340 345 350

Thr Asn Ile Leu His Met Pro Ser Leu Asn Glu Glu Arg Thr Phe Gly
355 360 365

Trp Lys Gly Gly Asp Val Tyr Leu Pro Asn Val Pro Lys Thr Ala Ile
370 375 380

Val Ala Gly Asp Arg Thr Arg Leu Gly Gly Glu Ile Leu Ala Ser Val
385 390 395 400

Ala Asn Ala Leu Asn Gln Glu Glu Val Tyr Ser Ser Val Val Ser Ser
405 410 415

Ile Thr Asn Arg Leu Val Leu Arg Asp Gln Ser Ala Leu Leu Ser His
420 425 430

Leu Asp Thr Lys Leu Cys Asp Met Phe Ser Gln Arg Asp Ala Met Ile
435 440 445

Arg Glu Lys Pro Ser His Arg Cys Asp Val Phe Leu Lys Pro Arg Glu
450 455 460

Arg Glu Lys Leu Arg Glu Leu Phe Pro Glu Leu Ser Ile Gln Phe Ser
465 470 475 480

Asp Ser Val Arg Ser Ser His Pro Phe Ala Asn Ala Met Arg Ser Cys
485 490 495

Phe Asn Gly Ile Phe Ser Arg Arg Cys Gly Asn Val Cys Phe Phe Asp
500 505 510

Ile Gly Gly Ser Phe Thr Tyr His Val Lys Ala Gly His Val Asn Cys
515 520 525

His Val Cys Asn Pro Val Leu Asp Val Lys Asp Val Lys Arg Arg Ile
530 535 540

Asn Glu Ile Leu Phe Leu Ser Thr Ala Gly Gly Asp Ser Tyr Val Ser
545 550 555 560

Ser Asp Leu Leu Thr Glu Ala Ala Ser Lys Ser Val Ser Tyr Cys Ser
565 570 575

Arg Glu Ser Gln Asn Cys Asp Ser Arg Ala Asp Ala Gly Phe Met Val
580 585 590

Asp Val Tyr Asp Ile Ser Pro Gln Gln Val Ala Glu Ala Met Asp Lys
595 600 605

Lys Gly Ala Leu Val Phe Asp Ile Ala Leu Met Phe Pro Val Glu Leu
610 615 620

Leu Tyr Gly Asn Gly Glu Val Tyr Leu Glu Glu Leu Asp Thr Leu Val
625 630 635 640

Lys Arg Glu Gly Asp Tyr Leu Ala Tyr Asn Val Gly Gln Cys Gly Glu
645 650 655

Met Tyr Glu His Ser Phe Ser Asn Val Ser Gly Phe Phe Thr Phe Ser
660 665 670

Tyr Val Arg Thr Ser Ser Gly Asn Val Phe Lys Leu Glu Tyr Glu Gly
675 680 685

Tyr Arg Cys Gly Tyr His His Leu Thr Met Cys Arg Ala Gln Lys Ser
690 695 700

Pro Gly Thr Glu Val Thr Tyr Arg Ser Leu Val Pro Ser Phe Val Gly
705 710 715 720

Lys Ser Leu Val Phe Ile Pro Val Val Ala Gly Ser Ser Val Ser Phe
725 730 735

Lys Thr Ile Val Leu Asp Ser Asp Phe Val Asp Arg Ile Tyr Ser Tyr
740 745 750

Ala Leu Asn Thr Ile Gly Thr Phe Glu Asn Arg Thr Phe Glu Tyr Ala
755 760 765

Val Gly Ala Val Arg Ser Gln Lys Thr His Val Ile Thr Gly Ser Arg
770 775 780

Val Val His Ser Lys Val Asp Ile Ser Pro Asp Asp Met Trp Gly Leu
785 790 795 800

Val Val Ala Val Met Ala Gln Ala Ile Lys Asp Arg Ala Lys Ser Ile
805 810 815

Arg Ser Tyr Asn Phe Ile Lys Ala Ser Glu Gly Ser Leu Ala Gly Val
820 825 830

```
Phe Lys Leu Phe Phe Gln Thr Val Gly Asp Cys Phe Ser Asn Ala Val
        835                 840                 845

Ser Val Tyr Ala Lys Ala Met Val His Asp Asn Phe Asn Val Leu Glu
    850                 855                 860

Thr Leu Met Ser Met Pro Arg Ala Phe Ile Arg Lys Val Pro Gly Ser
865                 870                 875                 880

Val Val Val Thr Ile Cys Thr Ser Gly Ala Ser Asp Arg Leu Glu Leu
                885                 890                 895

Arg Gly Ala Phe Asp Ile Ser Lys Glu Thr Phe Gly Arg Lys Leu Lys
            900                 905                 910

Asn Ser Arg Leu Arg Val Phe Ser Arg Ala Ile Val Glu Asp Ser Ile
        915                 920                 925

Lys Val Met Lys Ala Met Lys Thr Glu Asp Gly Lys Pro Leu Pro Ile
    930                 935                 940

Thr Glu Asp Ser Val Tyr Ala Phe Ile Met Gly Asn Val Ser Asn Val
945                 950                 955                 960

His Cys Thr Arg Ala Gly Leu Leu Gly Gly Ser Lys Ala Thr Val Val
                965                 970                 975

Ser Ser Val Ser Lys Gly Leu Val Ala Arg Gly Ala Ala Thr Lys Ala
            980                 985                 990

Phe Ser Gly Ile Thr Ser Phe Phe Ser Thr Gly Ser Leu Phe Tyr Asp
        995                1000                1005

Arg Gly Leu Thr Glu Asp Glu Arg Leu Asp Ala Leu Val Arg Thr Glu
   1010                1015                1020

Asn Ala Ile Asn Ser Pro Val Gly Ile Leu Glu Thr Ser Arg Val Ala
1025                1030                1035                1040

Val Ser Lys Val Val Ala Gly Thr Lys Glu Phe Trp Ser Glu Val Ser
                1045                1050                1055

Leu Asn Asp Phe Thr Thr Phe Val Leu Arg Asn Lys Val Leu Ile Gly
            1060                1065                1070

Ile Phe Val Ala Ser Leu Gly Ala Ala Pro Ile Ala Trp Lys Tyr Arg
        1075                1080                1085
```

```
Arg Gly Ile Ala Ala Asn Ala Arg Arg Tyr Ala Gly Ser Ser Tyr Glu
   1090                1095                1100

Thr Leu Ser Ser Leu Ser Ser Gln Ala Ala Gly Gly Leu Arg Gly Leu
1105                1110                1115                1120

Thr Ser Ser Thr Val Ser Gly Gly Ser Leu Val Val Arg Arg Gly Phe
                1125                1130                1135

Ser Ser Ala Val Thr Val Thr Arg Ala Thr Val Ala Lys Arg Gln Val
            1140                1145                1150

Pro Leu Ala Leu Leu Ser Phe Ser Thr Ser Tyr Ala Ile Ser Gly Cys
        1155                1160                1165

Ser Met Leu Gly Ile Trp Ala His Ala Leu Pro Arg His Leu Met Phe
   1170                1175                1180

Phe Phe Gly Leu Gly Thr Leu Leu Gly Ala Arg Ala Ser Ala Asn Thr
1185                1190                1195                1200

Trp Lys Phe Gly Gly Phe Ser Asn Asn Trp Cys Ala Val Pro Glu Val
                1205                1210                1215

Val Trp Arg Gly Lys Ser Val Ser Ser Leu Leu Leu Pro Ile Thr Leu
            1220                1225                1230

Gly Val Ser Leu Ile Ile Arg Gly Leu Leu Asn Asp Thr Ile Pro Gln
        1235                1240                1245

Leu Ala Tyr Val Pro Pro Val Glu Gly Arg Asn Val Tyr Asp Glu Thr
   1250                1255                1260

Leu Arg Tyr Tyr Arg Asp Phe Asp Tyr Asp Glu Gly Ala Gly Pro Ser
1265                1270                1275                1280

Gly Thr Gln His Glu Ala Val Pro Gly Asp Asp Asn Asp Gly Ser Thr
                1285                1290                1295

Ser Ser Val Ser Ser Tyr Asp Val Val Thr Asn Val Arg Asp Val Gly
            1300                1305                1310

Ile Ser Thr Asn Gly Glu Val Thr Gly Glu Glu Glu Thr His Ser Pro
        1315                1320                1325

Arg Ser Val Gln Tyr Thr Tyr Val Glu Glu Glu Val Ala Pro Ser Ala
   1330                1335                1340
```

```
Ala Val Ala Glu Arg Gln Gly Asp Pro Ser Gly Ser Gly Thr Ala Asp
1345                1350                1355                1360

Ala Met Ala Phe Val Glu Ser Val Lys Lys Gly Val Asp Asp Val Phe
                1365                1370                1375

His Gln Gln Ser Ser Gly Glu Thr Ala Arg Glu Val Glu Val Asp Gly
            1380                1385                1390

Lys Gly Leu Leu Pro Glu Ser Val Val Gly Glu Ala Pro Thr Gln Glu
        1395                1400                1405

Arg Gly Arg Ala Ala Asp Gly Asn Thr Ala Gln Thr Ala Val Asn Glu
    1410                1415                1420

Gly Asp Arg Glu Pro Val Gln Ser Ser Leu Val Ser Ser Pro Gln Ala
1425                1430                1435                1440

Asp Ile Pro Lys Val Thr Gln Ser Glu Val His Ala Gln Lys Glu Val
                1445                1450                1455

Lys Gln Glu Val Pro Leu Ala Thr Val Ser Gly Ala Thr Pro Ile Val
            1460                1465                1470

Asp Glu Lys Pro Ala Pro Ser Val Thr Thr Arg Gly Val Lys Ile Ile
        1475                1480                1485

Asp Lys Gly Lys Ala Val Ala His Val Ala Glu Lys Lys Gln Val Gln
    1490                1495                1500

Val Glu Gln Pro Lys Gln Arg Ser Leu Thr Ile Asn Glu Gly Lys Ala
1505                1510                1515                1520

Gly Lys Gln Leu Cys Met Phe Arg Thr Cys Ser Cys Gly Val Gln Leu
                1525                1530                1535

Asp Val Tyr Asn Glu Ala Thr Ile Ala Thr Arg Phe Ser Asn Ala Phe
            1540                1545                1550

Thr Phe Val Asp Asn Leu Lys Gly Arg Ser Ala Val Phe Phe Ser Lys
        1555                1560                1565

Leu Gly Glu Gly Tyr Thr Tyr Asn Gly Gly Ser His Val Ser Ser Gly
    1570                1575                1580

Trp Pro Arg Ala Leu Glu Asp Ile Leu Thr Ala Ile Lys Tyr Pro Ser
1585                1590                1595                1600
```

Val Phe Asp His Cys Leu Val Gln Lys Tyr Lys Met Gly Gly Gly Val
1605 1610 1615

Pro Phe His Ala Asp Asp Glu Glu Cys Tyr Pro Ser Asp Asn Pro Ile
1620 1625 1630

Leu Thr Val Asn Leu Val Gly Lys Ala Asn Phe Ser Thr Lys Cys Arg
1635 1640 1645

Lys Gly Gly Lys Val Met Val Ile Asn Val Ala Ser Gly Asp Tyr Phe
1650 1655 1660

Leu Met Pro Cys Gly Phe Gln Arg Thr His Leu His Ser Val Asn Ser
1665 1670 1675 1680

Ile Asp Glu Gly Arg Ile Ser Leu Thr Phe Arg Ala Thr Arg Arg Val
1685 1690 1695

Phe Gly Val Gly Arg Met Leu Gln Leu Ala Gly Gly Val Ser Asp Glu
1700 1705 1710

Lys Ser Pro Gly Val Pro Asn Gln Gln Pro Gln Ser Gln Gly Ala Thr
1715 1720 1725

Arg Thr Ile Thr Pro Lys Ser Gly Gly Lys Ala Leu Ser Glu Gly Ser
1730 1735 1740

Gly Arg Glu Val Lys Gly Arg Ser Thr Tyr Ser Ile Trp Cys Glu Gln
1745 1750 1755 1760

Asp Tyr Val Arg Lys Cys Glu Trp Leu Arg Ala Asp Asn Pro Val Met
1765 1770 1775

Ala Leu Glu Pro Asp Tyr Thr Pro Met Thr Phe Glu Val Val Lys Thr
1780 1785 1790

Gly Thr Ser Glu Asp Ala Val Val Glu Tyr Leu Lys Tyr Leu Ala Ile
1795 1800 1805

Gly Ile Glu Arg Thr Tyr Arg Ala Leu Leu Met Ala Arg Asn Ile Ala
1810 1815 1820

Val Thr Thr Ala Glu Gly Val Leu Lys Val Pro Asn Gln Val Tyr Glu
1825 1830 1835 1840

Ser Leu Pro Gly Phe His Val Tyr Lys Ser Gly Thr Asp Leu Ile Phe
1845 1850 1855

His Ser Thr Gln Asp Gly Leu Arg Val Arg Asp Leu Pro Tyr Val Leu
1860 1865 1870

Ile Ala Glu Lys Gly Ile Phe Thr Lys Gly Lys Asp Val Asp Ala Val
1875 1880 1885

Val Ala Leu Gly Asp Asn Leu Phe Val Cys Asp Asp Ile Leu Val Phe
1890 1895 1900

His Asp Ala Ile Asn Leu Ile Gly Ala Leu Lys Val Ala Arg Cys Gly
1905 1910 1915 1920

Met Val Gly Glu Ser Phe Lys Ser Phe Glu Tyr Lys Cys Tyr Asn Ala
1925 1930 1935

Pro Pro Gly Gly Gly Lys Thr Thr Thr Leu Val Asp Glu Phe Val Lys
1940 1945 1950

Ser Pro Asn Ser Thr Ala Thr Ile Thr Ala Asn Val Gly Ser Ser Glu
1955 1960 1965

Asp Ile Asn Met Ala Val Lys Lys Arg Asp Pro Asn Leu Glu Gly Leu
1970 1975 1980

Asn Ser Ala Thr Thr Val Asn Ser Arg Val Val Asn Phe Ile Val Arg
1985 1990 1995 2000

Gly Met Tyr Lys Arg Val Leu Val Asp Glu Val His Met Met His Gln
2005 2010 2015

Gly Leu Leu Gln Leu Gly Val Phe Ala Thr Gly Ala Ser Glu Gly Leu
2020 2025 2030

Phe Phe Gly Asp Ile Asn Gln Ile Pro Phe Ile Asn Arg Glu Lys Val
2035 2040 2045

Phe Arg Met Asp Cys Ala Val Phe Val Pro Lys Lys Glu Ser Val Val
2050 2055 2060

Tyr Thr Ser Lys Ser Tyr Arg Cys Pro Leu Asp Val Cys Tyr Leu Leu
2065 2070 2075 2080

Ser Ser Met Thr Val Arg Gly Thr Glu Lys Cys Tyr Pro Glu Lys Val
2085 2090 2095

Val Ser Gly Lys Asp Lys Pro Val Val Arg Ser Leu Ser Lys Arg Pro
2100 2105 2110

Ile Gly Thr Thr Asp Asp Val Ala Glu Ile Asn Ala Asp Val Tyr Leu
2115 2120 2125

Cys Met Thr Gln Leu Glu Lys Ser Asp Met Lys Arg Ser Leu Lys Gly
2130 2135 2140

Lys Gly Lys Glu Thr Pro Val Met Thr Val His Glu Ala Gln Gly Lys
2145 2150 2155 2160

Thr Phe Ser Asp Val Val Leu Phe Arg Thr Lys Lys Ala Asp Asp Ser
2165 2170 2175

Leu Phe Thr Lys Gln Pro His Ile Leu Val Gly Leu Ser Arg His Thr
2180 2185 2190

Arg Ser Leu Val Tyr Ala Ala Leu Ser Ser Lys Leu Asp Asp Lys Val
2195 2200 2205

Gly Thr Tyr Ile Ser Asp Ala Ser Pro Gln Ser Val Ser Asp Ala Leu
2210 2215 2220

Leu His Thr Phe Ala Pro Ala Gly Cys Phe Arg Gly Ile
2225 2230 2235